

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

Reserve
a3F395
.U52

AD-33 Bookplate
(1-63)

NATIONAL

**A
G
R
I
C
U
L
T
U
R
A
L**



LIBRARY

FEBRUARY 1976

○
SWINE RESEARCH
AT THE
U. S. MEAT ANIMAL RESEARCH CENTER¹

U. S. DEPT. OF AGRICULTURE
NATIONAL ARCHIVES

MAR 26 1974

CATALOGING - PREP.

¹North Central Region, Agricultural Research Service, U. S. Department of Agriculture

U. S. MEAT ANIMAL RESEARCH CENTER¹

Clay Center, Nebraska

SWINE RESEARCH PROGRAM

INTRODUCTION

The swine research program at the U. S. Meat Animal Research Center will be comprehensive in nature with research efforts involving all segments of the production cycle. Initially, all research efforts are focusing on the problems associated with complete confinement production systems. However, facilities have been designed and constructed to provide the capability to investigate problems involving different degrees of confinement. Because of the reproduction problems identified with complete confinement production systems, initial plans are to conduct all aspects of the swine research program under housed conditions.

Research programs with swine are being initiated with efforts beginning in 1974. Contract construction of swine research facilities was completed in late 1973. Internal improvements in these structures were not provided by the contract construction but have been provided by the "in house" construction capability. During 1974 and 1975 the "in house" construction effort has given highest priority to providing internal improvements in swine facilities. These improvements have been essentially completed and lack of adequate facilities is no longer a major constraint to the research program with swine. There are only two units in the swine research complex in which internal improvements remain to be done. These are a nursery unit and a unit for highly intensive research efforts. It is planned to complete the nursery unit in 1976.

Swine populations for research purposes were introduced by hysterectomy procedures in 1973. There have been some delays in increasing numbers because of poor reproductive performance of the gilts taken by hysterectomy. However, swine populations appropriate for meeting the research requirements are now approaching the point where this will not be a constraint to the research program.

Approximately one-fourth of research staff time is now budgeted to the swine research program. Thus, with the excellent research facilities now available and with the commitment of research staff time to the swine research program, there is every reason to expect the swine research program to develop rapidly.

¹North Central Region, Agricultural Research Service, U. S. Department of Agriculture.

Research efforts are organized on a multidiscipline basis to most effectively gain understanding of biological and physical phenomena relevant to the solution of problems associated with production efficiency and carcass desirability. For convenience, research programs in this document are presented on the basis of discipline and research areas are listed under the Research Unit providing primary leadership for a particular research effort.

I. GENETICS AND BREEDING

A. General Objective. Develop and evaluate breeding systems and selection criteria and procedures designed to use genetic variation within and among existing breeds for improving efficiency and quality of pork production under present and future production and marketing situations.

B. Specific Programs.

1. Research Area:

Evaluation in crossbred swine of effects from long-term selection on backfat alone compared to general selection in the same breeds.

a. Objectives:

- (1) Compare the cumulative genetic changes in reproduction, growth, feed utilization and carcass composition of Duroc x Yorkshire crossbreds produced by two decades of selection solely for extreme high- or low-backfat deposition with changes produced by general selection in the industry within these breeds during the same period.
- (2) Use correlated responses from backfat and general selection as a guide in developing effective selection criteria and procedures for improving efficiency and quality of lean pork production.

b. Procedure and Progress:

In 1973, the following pigs were obtained by hysterectomy; 109 gilts and 68 boars from 31 litters of genetically high- and low-backfat and unselected control Beltsville lines in each of the Duroc and Yorkshire breeds plus representative contemporary Duroc (48 gilts and 12 boars from 12 litters) and Yorkshire (45 gilts and 9 boars from 11 litters) purebreds. Reciprocal crossbred matings within each type of selection were made to produce 57 crossbred litters from the three reciprocal Beltsville crosses (Duroc-low x Yorkshire-low, Duroc-high x Yorkshire-high, and Duroc-control x Yorkshire-control) and 17 litters from contemporary purebred Duroc x Yorkshire reciprocal crosses in June-July and November-December 1974. Pigs (236) from November-December litters were evaluated for stress susceptibility by the Halothane test.

Crossbred barrows and gilts were fed by litters from weaning at six weeks of age to 210 lb with feed consumption and live weights recorded at 28-day intervals. At market weight, gilts were probed for backfat thickness and 209 barrows were slaughtered to obtain yield, carcass and leg length, loin eye area, backfat thickness, scores evaluating fresh pork quality, yields of untrimmed, of skinned defatted and of boneless hams and loin fat; plus 10th rib chop chemical composition of soft tissue of longissimus muscle, shear tenderness, cooking loss and water holding capacity. Age at puberty, fertility and first and second litter performance is being recorded on about 225 crossbred gilts of these four types.

c. Current Status and Research Plans:

Data collection will be completed in May 1976 and the project will be terminated. Results will be analyzed and published.

2. Research Area:

Selection methods and breeding systems for improvement of maternal performance in swine.

a. Objectives:

- (1) Develop selection criteria and procedures for maximizing genetic improvement of maternal traits.
- (2) Evaluate initial performance and differential response to selection for maternal characteristics in a two-breed synthetic versus that in the parental purebreds from which the synthetic was derived.

b. Procedure and Progress:

This project is scheduled for initiation in mid to late 1976 at which time 60 each of Duroc and Yorkshire gilts of the same age will be available as foundation females. Samples of the British Landrace and Large White breeds have been introduced by Caesarean SPF procedures in January-February 1976. This study involves initial contemporary comparisons of F₁ reciprocal crosses and F₂ and F₃ inter se matings with parental purebreds and will be managed on strictly a gilt litter basis. Performance traits in boars and gilts to be recorded and evaluated include body weight at birth, weaning, and at 28-day intervals until 200 lb; tolerance to halothane to estimate incidence of porcine stress syndrome; and backfat thickness at 200 lb. In gilts, age at puberty, number of pigs farrowed, number of pigs weaned and growth rate of litters during lactation will be recorded.

C. Future Research Plans.

Genetics and breeding research at the U. S. Meat Animal Research Center will focus on the development and evaluation of breeding systems relating to total confinement production. Through multi-discipline research an understanding of the biological basis for genetic variation will be developed with the objective of developing technology for producing swine which are more suited for the stresses of confinement and possess the carcass characteristics desired by the consumer.

Emphasis will be given to the development and evaluation of maternal and paternal population selection criteria and procedures with attention to the development and evaluation of new breeds based on a multi-breed foundation for use in specific crossbreeding systems as an alternative to rotational crossbreeding systems.

II. NUTRITION

A. General Objective. Determine nutritive requirements and develop feeding programs for growth and reproduction to promote optimum performance in all stages of the life cycle and to produce a high yield of high quality edible portion in the carcass in confinement production systems.

B. Specific Programs.

1. Research Area:

Utilization of high-fiber diets by the growing-finishing and reproducing animal.

a. Objectives:

- (1) Determine morphological and functional changes in the digestive tract resulting from feeding high-fiber diets from 8 weeks of age to 250 lb.
- (2) Determine biochemical characteristics of ingesta at different points in the digestive tract as influenced by feeding high-fiber diets.
- (3) Determine effect of diet during growth to 250 lb on the ability to subsequently utilize a 20% fiber diet.
- (4) Determine the influence of high-fiber consumption upon reproductive performance of gilts and sows.

b. Procedure and Progress:

At 7 to 9 weeks of age, barrows and gilts were placed on either corn-soy or a high-fiber pelleted ration with the source of fiber being either dehydrated alfalfa meal or solka-floc. Percent crude fiber was gradually increased from 6% to 20% during the growing-finishing period in the two high-fiber rations.

At 250 lb, barrows were slaughtered 2 or 5 hours after feeding and total weight of gastrointestinal tract plus contents was determined. The gastrointestinal tract was segmented and the following parameters evaluated in each segment: weight, weight of contents, pH of contents, amount of dry matter in tissue, amount of dry matter in contents; total volatile fatty acids, lactate and ammonia nitrogen in contents and histological appearance of tissue. Additional barrows that had been fed one of the three experimental rations were placed on a diet containing 82% alfalfa meal for five weeks beginning at 250 lb. Performance was evaluated to determine effect of form and level of fiber during growth to 250 lb on ability to utilize a high alfalfa diet subsequent to reaching 250 lb live weight. After five weeks, rate of passage of the high alfalfa diet, as influenced by previous dietary history, was determined.

In gilts fed corn-soy or alfalfa rations, age and weight at puberty were observed and these females are being continued through breeding, gestation and lactation to evaluate the effect of high levels of alfalfa upon reproductive performance.

c. Research Plans:

Continue efforts in this area to obtain necessary information required to develop procedures for greater utilization of forages in swine production systems.

2. Research Area:

Influence of energy intake upon efficiency and composition of growth in growing-finishing pigs.

a. Objectives:

- (1) Determine effects of duration and level of energy restriction during the growing-finishing period upon rate of fat and lean deposition, pork quality and efficiency of feed conversion.

- (2) Determine relative fat and lean composition of the carcass and pork quality at a constant live weight following energy restriction during different portions of the growing-finishing period.
- (3) Determine the potential for reducing cost of producing lean pork through restriction of energy intake.

b. Procedure and Progress:

The initial study in this area was started in August 1975 and utilized 330 Hampshire-sired barrows and gilts from the first litters from control, high-fat, low-fat, and commercial Duroc-Yorkshire crossbred gilts. Levels of intake during the growing period are ad libitum, 87.5% ad libitum, and 75% ad libitum. During the finishing period, pigs are kept at the level of intake maintained during the growing period or placed on a lower level of intake based upon the intake of ad libitum fed controls. Animals in restricted groups are fed twice daily.

Backfat thickness is being determined at 28-day intervals beginning at 16 weeks of age and representative animals from each group are being slaughtered at three constant ages when the ad libitum fed pigs reach a live weight of 220, 240 and 260 lb and a single constant weight of 240 lb for all treatments. Data obtained at slaughter includes live weight, hot carcass weight, carcass length, leg length, backfat thickness, loin eye area, weight of separated untrimmed, skinned, defatted and deboned ham; and color, marbling, firmness, and texture score of loin muscle.

c. Research Plans:

Efforts will continue in this research area to develop nutrition and management procedures required to synchronize nutrient intake with metabolic efficiency for lean tissue deposition and optimum carcass composition.

3. Research Area:

Effects of maternal nutrition upon fetal development, early postnatal performance of pigs and reproduction.

a. Objectives:

- (1) Determine nutritional requirements to obtain optimal pre- and postnatal pig survival and sow reproductive performance.
- (2) Determine growth and development pattern of the fetus from 93 to 114 days of pregnancy following energy restriction prior to day 93.

- (3) Determine effects of maternal nutrition late in gestation upon cell growth and body composition of fetus and pigs at birth.
- (4) Determine nutrient requirements of gilts and sows from 93 to 114 days of gestation following minimal nutrient intake prior to this stage of gestation.

b. Procedure and Progress:

Initial studies in this area will begin in 1976. Sows will be maintained on four levels of energy, ranging from 3,900 to 6,500 Kcal/day, during gestation. A portion of the sows at each energy level are scheduled to be slaughtered at 93 days of pregnancy while the remaining sows will farrow. In additional sows, energy intake will be increased by varying increments on day 93 to observe the effects of increasing energy during the last three weeks of gestation on late prenatal growth, perinatal mortality and subsequent postnatal performance. Measurements to be obtained are body weight changes during gestation; serum levels of beta hydroxybutyric acid and urea nitrogen at breeding, 30, 60, 93 and 110 days of gestation; and fetal weight and body length of pigs from litters of sows slaughtered on day 93. Total body fat, protein, ash and glycogen will be determined in three representative pigs per litter from all litters at day 93 of pregnancy and at farrowing.

c. Research Plans:

These efforts will be highly integrated with efforts by scientists in the reproduction area.

4. Research Area:

Management and environmental factors on growth, feed efficiency and reproduction.

a. Objectives:

- (1) Determine space requirements for optimum performance levels in growing-finishing animals.
- (2) Determine effect of restricted pen size on growth rate and efficiency in growing-finishing gilts.
- (3) Observe effect of pen size on onset of first estrus.
- (4) Observe changes in LDH (lactate dehydrogenase) activity and isoenzyme patterns to determine if this can be used as an indicator of chronic stress.

b. Procedure and Progress:

Gilts weighing 45 to 55 lb were limited to two or four square feet per pig. Available floor space was increased by one square foot per pen in control pens and one-half square foot per pig in restricted pens as average weight of pen reached specified 30 lb increments. Body weight and feed efficiency were determined weekly. One day prior to expansion of a given pen, blood samples were obtained from all gilts in that pen and LDH activity and isoenzyme patterns were determined. Daily observation for estrus was begun when gilts reached 4 months of age.

The third experiment is in progress to evaluate pen size on growth, feed efficiency and puberty. Efforts in this area will be continued and will be expanded to include such factors as air movement, pre-adjustment to restriction and other management and environmental factors.

c. Future Research Plans.

As demand for feed grains increase, the objectives of nonruminant research must focus on improving feed efficiency. At the U. S. Meat Animal Research Center, high priority will be placed on the area of digestive physiology with plans to staff the scientists necessary to develop and conduct research into the factors which affect digestability and utilization of different diets, rate of passage through the gastrointestinal tract, appetite, and how these factors interact to influence feed efficiency. Considerable variation exists among individual pigs in their ability to convert feed to lean meat. Understanding of the physiologic basis of this variation is required to develop the technology needed by the swine industry to reduce the amount of feed required to produce a pound of edible product. Facilities are excellent for studies in this research area and completion of the intensive research building will allow for individual feeding of large numbers of animals. Understanding of the biology of feed efficiency is necessary to increase feed and total production efficiency.

III. REPRODUCTION

A. General Objective. Develop a comprehensive research program on male and female reproductive function to increase number of pigs marketed per breeding animal. Methods of altering endocrine function offer an opportunity to increase sow productivity and a means of influencing growth and development of growing pigs.

B. Specific Programs.

1. Research Area:

Relationship of gonadotropic and androgenic hormones on reproduction and on protein anabolism and deposition in boars.

a. Objectives:

- (1) Investigate the mechanism of androgen activity in boars which results in increased feed efficiency and decreased fat deposition compared to barrows.
- (2) Quantify changes in LH and androgen concentrations in the blood of boars from birth to 200 lb.
- (3) Determine the relationship between LH and androgen production in boars.
- (4) Develop and evaluate means of altering androgen production to reduce the level of "boar odor" in carcasses from intact males without losing the advantages of feed efficiency and carcass composition.

b. Procedure and Progress:

A series of experiments have been initiated which will provide basic information relating to changes in reproductive hormones which occur as boars approach puberty. Changes in blood concentrations of LH, testosterone, androstendione, dehydroepiandrosterone and androstenone are being determined to gain an understanding of how changes in these hormones correlate with changes in feed efficiency and development of "boar odor" in the carcass. Also, changes in androgen levels are being monitored after treatment with LH, ACTH or synthetic steroids to evaluate ways of advantageously altering androgen production.

c. Research Plans:

Efforts will be expanded in this area to obtain the necessary understanding of the endocrinology of growth to utilize the male hormones and other phenomena of the male associated with increased efficiency of lean tissue development.

2. Research Area:

Develop procedures to decrease puberty age in gilts.

a. Objectives:

- (1) Obtain information necessary to initiate investigations into the apparent delay in puberty associated with some confinement managed gilts.
- (2) Develop means of regulating onset of first estrus in gilts.
- (3) Determine changes in LH and estrogen concentrations in gilts from birth to puberty.

b. Procedure and Progress:

Blood samples have been collected from gilts at weekly intervals, beginning on the day of farrowing and continuing through first estrus, to observe changes with age in LH and estradiol concentrations.

c. Research Plans:

These efforts will be closely associated with efforts in the Genetics and Breeding area for improvement of maternal performance.

3. Research Area:

Develop a procedure to evaluate stress in swine.

a. Objectives:

- (1) Determine changes in LDH activity, LDH isoenzyme patterns and cortisol levels during the stress of acute confinement.
- (2) Determine effect of duration of acute confinement on magnitude of changes in the above listed parameters and how these parameters change after stress is removed.

b. Procedure and Progress:

LDH activity and cortisol concentrations steadily increased from 15 to 60 minutes after restriction of movement in prepubertal gilts. Further studies are scheduled which will determine duration of these changes once the stress of acute confinement has been removed.

c. Research Plans:

Limited expansion of future efforts in this area are planned.

4. Research Area:

Conceptus structure, viability and survival in swine.

a. Objectives:

- (1) Develop procedures to aid in the choices of selection, nutrition and management procedures necessary to minimize early embryonic losses.
- (2) Determine morphological changes indicative of embryonic death in swine.

- (3) Evaluate biochemical and staining methods for investigating embryonic death in swine.
- (4) Investigate timing of embryonic losses during the first 30 days of gestation.

b. Procedure and Progress:

These investigations will begin in 1976. Sows will be assigned to a PMS-HCG treatment regime at the end of a three-week lactation. After mating, laparotomies will be scheduled in a sequential manner to determine time and duration of ovulation with a second laparotomy after ovulation to recover ova which will be fixed, stained and examined microscopically to study zygote developmental changes. In a second group of sows, ovariectomized after mating to induce embryo death, fertilized ova recovered at various intervals after ovariectomy will be divided into two groups. In one group the ova will be fixed immediately while the second group will be cultured in vitro before fixation. After staining, zygotes will be examined microscopically to determine morphological changes associated with early embryo death.

5. Research Area:

Role of prolactin in regulation of porcine corpus luteum function.

a. Objectives:

- (1) Observe effect of suppressed prolactin secretion on progesterone levels and estrous cycle length in gilts.
- (2) Determine if suppressed prolactin secretion will interrupt luteal function in hysterectomized or pregnant gilts.
- (3) Evaluate endocrine control of porcine corpus luteum function to develop effective estrous synchronization techniques.

b. Procedure and Progress:

Scheduled for initiation in early 1976, these experiments will utilize 110 gilts. The role of prolactin in maintenance of corpus luteum function in cycling, pregnant and hysterectomized gilts will be investigated by suppressing prolactin secretion with ergocryptine. Luteal activity will be monitored by observing changes in estrous cycle length and progesterone levels.

6. Research Area:

Endocrine and physiological factors related to lactation and rebreeding.

a. Objectives:

- (1) Determine endocrine and physiologic mechanisms influenced by lactation in the sow.
- (2) Increase rebreeding efficiency of the sow following lactation.

b. Procedure and Progress:

Research plans in this area have not been finalized and efforts will be closely coordinated with that in nutrition. Studies are planned which will investigate the interactions between the suckling stimulus, stimuli originating from the litter, and the process of lactation per se to gain an understanding of how factors associated with lactation suppress ovarian cycles. Pigs will be weaned at different stages and sows managed in ways known to influence the return to estrus.

C. Future Research Plans.

Because reproductive problems unique to confinement management systems continue to adversely affect the efficiency of pork production, this area of research will receive high priority in planning and staffing of the U. S. Meat Animal Research Center. In order to develop techniques for eliminating the problems of delayed puberty in gilts and postpartum anestrus in sows, a full understanding of physiological and endocrinological changes associated with onset of sexual maturation is required. A second area anticipated to receive considerable attention is sexual activity in boars. Solutions to reproductive problems will be found only through an understanding of the basic physiologic processes involved and how these function uniquely in swine. Swine research facilities are complemented by excellent laboratory facilities and the present reproduction staff has the necessary training to conduct in depth studies in these areas with future staffing expected to complement the total research program.

IV. CARCASS AND MEATS

A. General Objective. Develop a comprehensive program to increase the lean-to-fat ratio, increase efficiency of lean tissue deposition and improve quality of the edible portion of the carcass.

B. Specific Programs.

Carcass and meats research is a component of Phase II in the development program of the U. S. Meat Animal Research Center with construction of facilities scheduled for completion near mid 1977. Staffing of carcass and meats research personnel will be expanded on an opportunity basis and research efforts will be closely coordinated with genetics and breeding, nutrition and physiology. With the availability of the Beltsville high- and low-backfat lines of pigs, efforts are being implemented involving biochemical and physiological studies of lipid metabolism.

1. Research Area:

Regulation of ionic calcium concentration in muscle and its relation to meat quality.

a. Objectives:

- (1) Characterize and compare the calcium regulatory function of muscle sarcoplasmic reticulum and sarcolemma in pork muscle.
- (2) Determine effect of pH and temperature on the regulatory mechanisms of these structures.

b. Procedure and Progress:

This study will provide information on the relationship of temperature and pH to postmortem muscle changes. A sample of ham muscle will be obtained by biopsy from market weight barrows and the sarcoplasmic reticulum and sarcolemma isolated. Calcium binding and accumulation and ATPase activity will be measured after these organelles have been incubated at different temperatures and pH.

C. Future Research Plans.

Improvement in carcass composition and meat quality requires development of a comprehensive research program investigating the factors that affect lipid and protein metabolism at the animal, tissue and cellular levels. The Beltsville high- and low-backfat lines of swine are being maintained to provide for comprehensive biochemical and physiological studies of lipid metabolism in these animals which will be instrumental in developing an understanding of the control of fat deposition in swine. After completion of Phase II construction in 1977, facilities will be excellent for conducting the basic carcass and meats research needed to develop the technology for improving carcass composition and meat quality.

V. AGRICULTURAL ENGINEERING

A. General Objective. Develop and evaluate procedures for improving production efficiency through the application of engineering principles to confinement production of swine.

B. Specific Programs.

Agricultural engineering is a component of Phase II development of the U. S. Meat Animal Research Center and presently, there is one agricultural engineer on the staff. The confinement swine facilities were designed so that research into the following areas could be undertaken and followed to completion.

1. Research Area:

Waste handling and treatment.

a. Objectives:

- (1) Design and construct waste handling and treatment facilities for optimum utilization of waste and provide for pollution control.
- (2) Develop the optimum design for flushing waste from confinement swine facilities.
- (3) Develop practical systems for the separation of solids in effluent from confinement flushing systems and subsequent treatment and utilization of the solid and liquid fractions.

b. Procedure and Progress:

Swine confinement buildings have been constructed with different floor designs and systems for waste handling to permit the development of optimum systems suitable for high density confinement production. Observations are being made on the effect of width and slope of gutter in growing-finishing facilities, optimum flushing volume and frequency, and the development of "housekeeping" habits of pigs of different ages and with different floor area. Construction is in progress on the waste treatment facilities for the effluent from swine confinement buildings. Facilities will provide for a comprehensive research program related to solids separation, anaerobic and aerobic treatment and disposal on soil.

2. Research Area:

Physical aspects of environment in confinement buildings.

a. Objectives:

- (1) Determine the role of pen size, flooring material and other physical aspects of the pig's environment on dunging habits, feet and leg problems, and animal performance.

b. Procedure and Progress:

Design variables built into confinement buildings include floor slope, slatted area, slat width, size and type of flushing gutter, pen size and shape, and heating and ventilation systems. The influence of these and other environmental variables on dunging habits, waste handling, feet and leg problems, and animal performance is being determined.

3. Research Area:

Airborne particles in confinement structures.

a. Objectives:

- (1) Determine factors influencing the concentration and transport of odor, dust, bacteria and viruses within confinement structures.
- (2) Determine the relationship of airborne particles in confinement structures to animal performance.

b. Procedure and Progress:

The air in confinement buildings will be monitored for the presence of airborne particles. Identification of organisms and inert materials will be related to animal condition and performance. Different floor, waste handling, and ventilation design will permit comparative observations between buildings.

4. Research Area:

Light and animal behavior.

a. Objectives:

- (1) Determine the role of intensity and location of light upon animal behavior and performance.
- (2) Determine the effect of light of different wave lengths upon animal behavior and performance.

b. Procedure and Progress:

Little is known of the pig's response to areas of contrasting light or light of different wave length. The effect of light intensity on dunging, sleeping and feeding habits of pigs of different ages will be observed. If light-affected behavior patterns are discerned, such information will be applied in the experimental design of pilot-scale facilities within confinement structures.

VI. HERD HEALTH AND DISEASE MANAGEMENT

A. General Objective. Utilize control afforded by the confinement facilities to develop procedures for preventing and controlling diseases encountered under conditions of strict confinement and establish control procedures applicable to production practice.

B. Specific Programs.

1. Research Area:

Pre- and post-farrowing addition of antibiotic to sow feed.

a. Objectives:

(1) Study the effectiveness of antibiotic addition to sow feed for two weeks prior and two weeks following farrowing.

b. Procedure and Progress:

Alternate sows are being fed the herd ration or this ration plus 0.42 gm of neomycin per day. Observations are also being made on the effectiveness of antibiotic addition to the water for pigs before weaning.

C. Future Research Plans.

The swine research facilities at the U. S. Meat Animal Research Center are uniquely suited for developing procedures of preventing and controlling diseases in complete confinement production systems. A comprehensive herd health and disease management research program is currently being planned and will be conducted in cooperation with the National Animal Disease Center and with other appropriate research interests.

VII. MANAGEMENT SYSTEMS

A. General Objective. Develop production practices for increasing the amount of high quality pork per unit of resource use. Determine relative priorities for alternative areas of research by identifying information voids which are most critical to the selection of production practices.

B. Specific Programs.

1. Research Area:

Model Simulation

a. Objectives:

- (1) Develop biological input-output models of herd dynamics, nutrient requirements and product yield which describe complete confinement production systems.
- (2) Experimentally validate component biological models.
- (3) Identify and assess relative priority of information deficiencies.

b. Research Plans:

The use of simulation modeling to evaluate alternative production strategies and establish research priorities is planned as the major thrust of swine management systems research. The simulation models essential to these efforts will be developed after, and adapted from, those for sheep and beef cattle. The live-animal validation of component models of herd dynamics, nutritional requirements and product yield will be integrated with experiments in the appropriate cooperating disciplines.

2. Research Area:

Production Systems

a. Objectives:

- (1) Determine labor and facility requirements for different confinement production systems.
- (2) Evaluate effect on total systems efficiency of management decisions; such as, age at weaning, number of litters per sow, weight at slaughter, or type of breeding program.
- (3) Quantify production costs and product returns for

different confinement production systems in order to evaluate economic, as well as biological efficiency.

- (4) Validate (with live-animal models) the more promising confinement production strategies.

b. Research Plans:

- (1) Management systems research will include live-animal validation of component models of herd management, nutritional requirements and quality and quantity of product yield for use in defining optimum confinement production systems.
- (2) The evaluation of alternative confinement systems will be initiated as the simulation models described in Research Area 1 are completed. The Economic Research Service economist located at the U. S. Meat Animal Research Center will make major inputs into this program. The flexibility to evaluate alternative confinement facilities was designed into the U. S. Meat Animal Research Center Swine Research Complex. It is anticipated that validation of complete production systems will be augmented through collaborative efforts with other research institutions and with private interests.

U. S. MEAT ANIMAL RESEARCH CENTER

PUBLICATIONS - SWINE

A. Scientific Journal Articles

Krehbiel, E. V., H. O. Hetzer, A. E. Flower, G. E. Dickerson, W. R. Harvey and L. A. Swiger. 1970. Effectiveness of reciprocal selection for performance of crosses between Montana No. 1 and Yorkshire swine. I. Prewaning traits. J. Anim. Sci. 32:191.

Krehbiel, E. V., H. O. Hetzer, A. E. Flower, G. E. Dickerson, W. R. Harvey and L. A. Swiger. 1970. Effectiveness of reciprocal selection for performance of crosses between Montana No. 1 and Yorkshire swine. II. Postweaning traits. J. Anim. Sci. 32:211.

Dickerson, G. E., H. O. Hetzer, E. V. Krehbiel and A. E. Flower. 1974. Effectiveness of reciprocal selection for performance of crosses between Montana No. 1 and Yorkshire swine. III. Expected and actual response. J. Anim. Sci. 39:24-41.

B. Abstracts

Dickerson, G. E. 1973. Expected and actual response to selection in swine. J. Anim. Sci. 37:232.

